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William Henry Hardinge, Esq., was elected a Member of the Committee of Antiquities in the room of Charles Haliday, Esq., who had resigned his place on that Committee.

Professor Jellett read to the meeting the following paper, describing—

A NEW ANALYZING PRISM.

In determining the plane of polarization of a ray by means of the ordinary Nicols' prism, the observer is required to arrest the rotation of the prism at the point at which the intensity of the transmitted light is a *minimum.* But it is difficult to do this with very great accuracy, inasmuch as the observer is obliged to compare a shade of colour, not with any other shade which is before his eyes at the same instant, but with his recollection of a shade observed at the previous instant. To insure any tolerable degree of accuracy, the observation must be made very rapidly, so that the eye may receive the new impression while the former one is still quite fresh in the memory. The difficulty of doing this with accuracy in any case is obvious, but it is most felt in experimenting on light reflected or transmitted by fluids. For here it is impossible to touch the instrument without producing a tremulous motion in the fluid, and, therefore, in the image reflected or transmitted; and this motion, while it lasts, renders accurate observation very difficult. But if the rotation of the analyzing prism be stopped for a sufficient length of time to allow this motion to cease, the recollection of the previously existing tint will no longer be so fresh as to allow the comparison to be made with any very great exactness. The difficulty will be increased, as is easily seen, when there is any amount of elliptic polarization in the light which is to be examined.

The remedy for this difficulty is to be sought in the construction of an analyzer in which the tints compared shall be *simultaneous,* not consecutive, and the double quartz plate of M. Arago is an attempt to realize this conception. It is not necessary to examine particularly this instrument, which is wholly different in principle and (the author believes) very inferior in accuracy to that which is now laid before the Academy, and which is constructed as follows:—

A rhombic prism of Iceland spar, whose longitudinal edges should have a length of about two inches, or a little more, is cut by two planes perpendicular to those edges, so as to form a right prism, as in Fig. 1. This prism is divided by a plane parallel to the edges, and making a small angle with the longer diagonal of the base; one of the two parts into which the prism is thus divided is then reversed, so as to place the base uppermost; the

Fig. 1.

two parts are cemented together, as in Fig. 2, with the surfaces of section in contact, and the ends of the prism thus formed are then ground and polished.

Now, it is evident from the construction of the prism, that if two rays of light parallel to the axis be made to traverse the two parts of the prism respectively, the lines of separation of the ordinary and extraordinary images in these two parts will be CA, CA′, Fig. 3, and as the angle between the plane of section and the longer diagonal is small, the angle ACA′ is nearly 180°. Hence the extraordinary refractions in the two parts are in nearly opposite directions, and if the end at which the light is admitted be so chosen that these refractions shall be *from* the plane of section, the separation of the images will be nearly doubled.

Fig. 2.

Now, suppose a circular beam of plane-polarized light to traverse the prism in a direction parallel to the sides, and so as to be equally divided by the plane of section, the emergent beam will consist of three separate parts, viz.: 1, a circular beam, OCO′, Fig. 3, formed by the union of the two ordinary beams; 2, two semicircular extraordinary beams, E, E′. If then the size of the incident beam be suitably determined, these latter may be completely separated from the ordinary beam, so as to admit of their being stopped by a diaphragm which allows the ordinary beam to pass; the instrument will then transmit a single beam of plane polarized light.

Fig. 3.

Now, it is easy to see that the planes of polarization of the two parts into which the beam is divided by the plane of section are inclined to each other at an angle somewhat less than double the angle DCS, Fig. 1. Suppose, then, that the plane of the paper being perpendicular to the beam, the traces of these planes of polarization are represented by AB, A′B′, and let CP, CP′ be perpendicular to these lines respectively. Let Cp be the plane of polarization of the ray to be examined. Then, so long as there is any difference between the angles PCp, P′Cp, the intensities of the two parts of the beam will be different, and conversely, if these intensities be equal, it is evident that the required plane of polarization will bisect the angle PCP′. The prism must, therefore, be turned on its axis until the equality of tints be established, and when this is done, the position Cp of the plane of polarization is known. It is not, however, necessary to determine the position of the planes PC, P′C. The observer commences by transmitting a beam whose plane of polari-

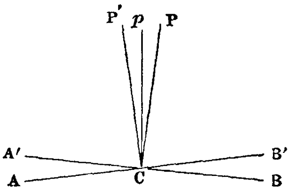

Fig. 4.

zation is known, and turning the analyzing prism until the tints become equal. The beam whose plane is required is then introduced, and when the equality of tints has been re-established, the angle through which the prism has revolved, read off on a graduated circle, gives the inclination of the required plane to the known plane. This mode of determining the zero, a process which for perfect accuracy ought to be repeated with each new set of observations, possesses the advantage of eliminating the personal equation of the observer. In examining a beam of any considerable magnitude, there will be found in different persons a tendency to think one part of the image darker than another, even when there is no real difference. With different observers, and even in the same person at different times, the part of the image thus preferred may be different, and if the zero were determined once for all, this might occasion sensible error. But as, in the method here given, such a preference will equally affect the position of the zero, it can have no influence on the final result.

In the first prism which the author procured to be constructed, the angle between the planes CP, CP′ was about 7°. With this prism the range of error in the determination of a plane of polarization was 7′, the light employed being the diffused light of the sky. Although this was a very much smaller range than the author had ever been able to attain with a Nicol's prism, it seemed that a greater amount of accuracy might be obtained, and as the brightness of the image appeared to be too great, a prism was constructed in which this angle was but half of its former value. With this prism, and with the same kind of light, the author finds that he can determine the position of the plane of polarization to 1′.

With direct solar light, and a prism in which the planes are still closer, a greater degree of accuracy may certainly be obtained; in fact, it can be shown that by diminishing this angle and increasing the brightness of the light, so as to preserve unchanged the intensity of the image, the sensibility of the prism will vary as $\cot \frac{\theta}{2}$, θ being the angle in question.

The author has given direction for the construction of an instrument in which this angle shall be one-half of that last mentioned, but as the polarimeter at his disposal is not made to measure an angle less than 1′, a greater degree of accuracy would not be of any practical advantage.

The prisms here described were executed by Mr. J. Bryson, of Prince's-street, Edinburgh, in a manner which left nothing to be desired.

Professor Kinahan read a paper, entitled, "Descriptions of Crangonidæ and Galatheidæ inhabiting the Irish seas, with Observations on the general homologies of the groups, and the propriety of subdividing the Britannic species of the former."

Sir William Rowan Hamilton, LL. D., M. R. I. A., communicated *the following portion of his paper*—